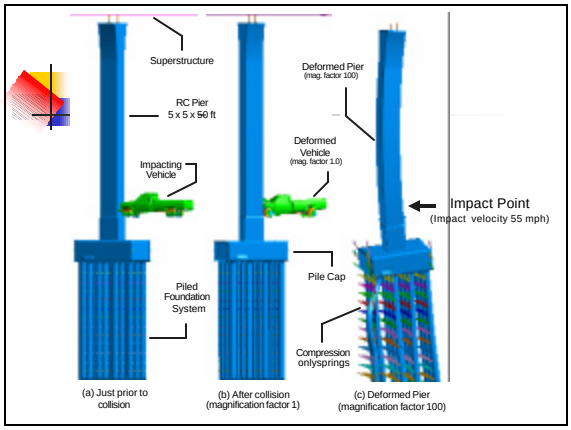
Transportation Research at UM
Dr. Will Hansen, University of Michigan
Civil Engineering

Transportation Summit Planning Team
Issue Exploration: Research & Evaluation
August 4, 2003

Technology Review -New Trends

- Bridge Research
- Pavement Research
- Materials Research

Field Testing of Bridges



Technology Review -New Trends

Reliability of Structures
- Reliability analysis procedures (load and resistance models)
- Development of design codes (bridges and buildings)

New Advanced Materials
- Self-Compacting Concrete

Advanced Structural Analysis
- FEM models for bridges

Field Testing Procedures
- Weigh in motion measurement of trucks
- Girder distribution factors, dynamic load factors
- Proof load tests

Technology Review -New Trends

•Bridge Research

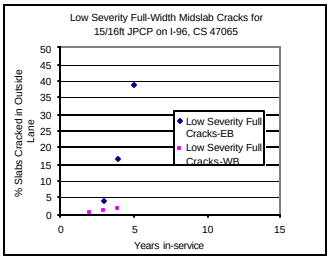
•Pavement Research

•Materials Research

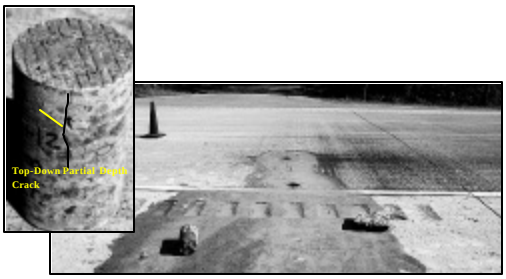
Premature Mid-Slab Fatigue Cracking
New Projects with Early Failure

Premature Distress Development

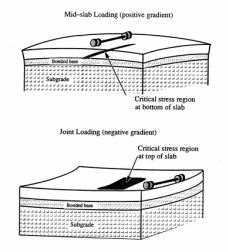
- Majority of transverse cracks in the outer traffic lane
- Cracks extend into passing lanes
- No joint faulting



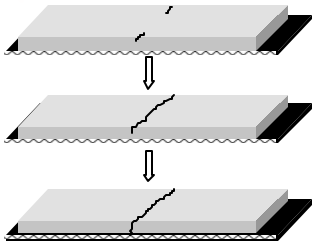
Premature Mid-Slab Fatigue Cracking
Field Coring on 3 Year Old JPCP Project



Bottom Up vs Top Down Cracking



Propagation of Rapid Slab Cracking as Observed from Field Surveys



Partial-depth edge crack

Partial-depth surface crack

Full-depth crack

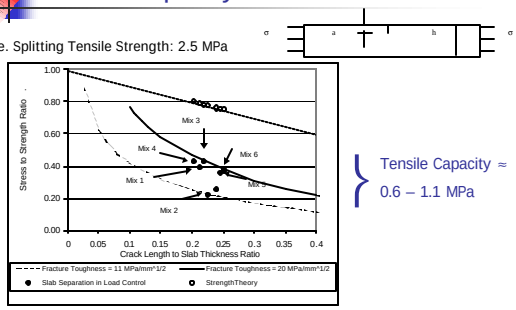
Cracking process agrees with laboratory testing
(Roesler and Barenberg, 1998)

Concrete Pavement Test Frame

Test System:
- Simulation of vehicle and in-plane loading
- Horizontal and vertical actuator
- In-Situ full-depth pavement layers
- Slab dimensions: 3m long; 1.8m wide, and 250mm thick.
- Can create a full-depth full-width tension crack
- Investigate aggregate interlock of a fully developed crack

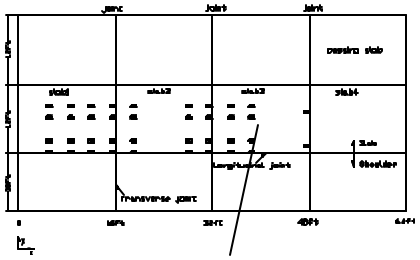
Effect of Surface Notch on JPCPs' Tensile Capacity

Ave. Splitting Tensile Strength: 2.5 MPa



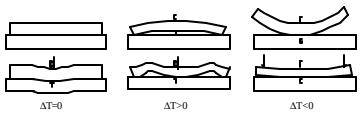
Tensile Capacity ≈ 0.6 – 1.1 MPa

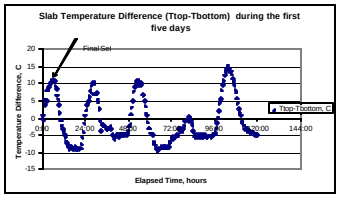
Ten-Axle Michigan Truck with 16 ft spacing between front (14 kip) axle and tandem (26 kip) axle



Maximum stress-center of slab

Slab Response to Temperature and Axle Loading





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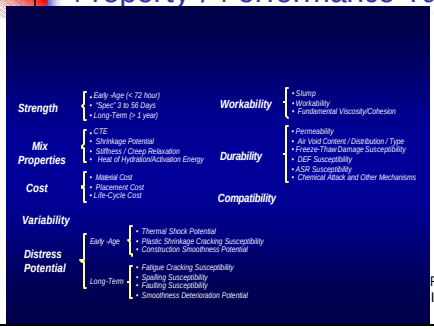
Property / Performance Targets



Ref: D. Harrington ISU

Use of Fiber Reinforced Cement-Based Composites to Improve Behavior of Structural Systems

Extensive reinforcement detailing is required in reinforced concrete members to assure a stable behavior during earthquakes.
The use of fiber reinforced cement- based composites with steel, polyethylene or PVA fibers is being evaluated to increase damage tolerance, displacement capacity and energy dissipation, while reducing normal reinforcement requirements in structural walls.
Findings from this research could lead to simpler structural wall systems able to sustain large earthquakes without significant damage

Damage Comparison of Flexural Elements (at 10% interstory drift)

R/C

R/ECC

State-of-the-art Servo-Hydraulic Mechanical Test Frames for Concrete Research

MDOT Research Partnerships with Four Major Michigan Universities Through Centers of Excellence

- 2 Pavement Centers
- 2 Bridge Centers
- 1 Transit Center
- 1 Materials Center

Annual MDOT Funding level/center: Approx. $250,000

Annual university contribution: Approx $50,000

Objectives of MDOT's Partnership with the Universities

- Identify design, construction and maintenance practices that enhance long-term performance and reduce life-cycle costs
- Provide training & technology transfer to new staff
- Assist MDOT in developing and monitoring new performance-based specifications that ensure improved long-term performance

Benefits of Transportation Research Centers

- Provide technical support in areas of core competency to address MDOT research needs, both immediate and long-term.
- Increased effectiveness of research investments through having dedicated investigators and staff who are able to focus on the implementation of research results through the development of functional research products.

Benefits of Transportation Research Centers

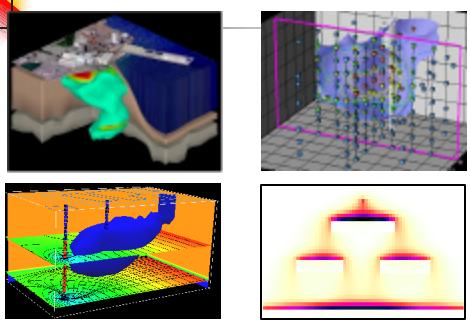
- Attract additional funding to Michigan universities through cooperative research with Federal transportation agencies.
- Education of highly skilled engineers that are potentially future MDOT employees

Other Transportation Related Cutting Edge Research Examples

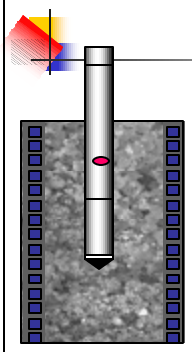
Construction Engineering & Management

- Modeling, optimization, design of construction processes
- Operations performance of large scale infrastructure systems

Groundwater Contamination



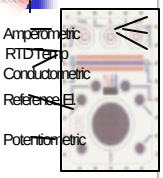
The Vision Cone Penetrometer



The Vision Cone Penetrometer (VisCPT) was developed at the University of Michigan in the late 1990's. By adapting miniature video cameras to the electronic cone, the VisCPT has overcome the major remaining shortcoming of the CPT, - the inability to visually observe and inspect the soil.

The VisCPT consists of two cameras, lenses and lighting systems with individual housing units. The two cameras record the soil images through synthetic sapphire windows. Each camera system operates at a different level of magnification thus providing fields of view between 2 mm and 20 mm (diagonal). The images are recorded continuously in real time as the probe is advanced at the standard CPT rate of 2 cm/sec.

Control of Toxic Plumes in Passenger Terminals



Use microsensors to detect toxic chemicals. A computer model finds optimal strategies for operating the existing ventilation system to eliminate the plume in real time.